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U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 1190

PROJECTILE ROTATING BANDS AND RELATED COMPONENTS

10th Partial Report

FRAGMENTATION TEST OF 3"/50 PROJECTILES MK 33 HAVING WELDED-OVERLAY ROTATING BANDS

FINAL Report

Task Assignment NPG-Re3b-225-1-53

Copy No. 72

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Fragmentation Test of 3"/50 Projectiles Mk 33 Having Welded-Overlay Rotating Bands

PART A

SYNOPSIS

1. This test was conducted to determine the effect of a welded-overlay rotating band on the fragmentation characteristics of the 3"/50 AA Projectile Mk 33.

2. a. The fragmentation characteristics of the projectile, Composition A-3 loaded and assembled with VT Fuze Mk 72, did not change significantly when the welded-overlay rotating band was substituted for the standard copper rotating band.

b. The comparative characteristics are as follows:

	Welded-Overlay band	Standard copper band
Average number of effective beam spray hits in total zone 45°-120°	334	318
Beam spray median velocity (ft/sec)	3090	3140
Average Number of fragments (1-1/4 - 205 grams)	517	510

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

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Having Welded-Overlay Rotating Bands

PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment NPG-Re3b-225-1-53, reference (b).

2. REFERENCES:

a. BUORD Rest ltr S78-1(54) Re3b-MRH/MAS:mt of 15 August 1952
b. BUORD Conf ltr NP9 Re3b-MRH:mt Ser 42696 of 29 July 1952
c. NPG Conf Report No. 1155 of 26 August 1953
d. NPG Conf Report No. 1077 of 2 February 1953
e. NPG Conf Report No. 468 of 31 January 1950

3. BACKGROUND:

a. References (c) and (d) reported the metallurgical and physical properties and ballistic performance of 3"/50 Mk 33 Mod 0 AA Projectiles having copper welded-overlay rotating bands. The welded-overlay method consists of applying an electric weld bead of band material to the periphery of the projectile, under an inert atmosphere, and machining the bead to the desired band contour. Its advantages include a considerable saving in band material and the elimination of the band seat.

b. The Bureau requested the Naval Proving Ground, in reference (a), to determine if the change in rotating bands would effect the projectile's fragmentation characteristics. The same type of projectile having the conventional copper rotating band was tested previously and reported in reference (e).

4. OBJECT OF TEST:

This test was conducted to determine the effect of a welded-overlay rotating band on the fragmentation characteristics of the 3"/50 AA Projectile Mk 33.

5. PERIOD OF TEST:

a.	Date Project Letter	15 August 1952
b.	Date All Necessary Material Received	13 November 1952
c.	Date Commenced Test	16 July 1953
d.	Test Completed	14 August 1953

Fragmentation Test of 3"/50 Projectiles Mk 33
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PART C

DETAILS OF TEST

6. DESCRIPTION OF ITEM UNDER TEST:

3"/50 Mk 33 Mod 0 Projectile with experimental copper welded-overlay rotating band, Lot W-1, Composition A-3 loaded, and assembled with VT Fuze Mk 72 (26 gram booster) modified for static detonation. The average weights of the ten (10) projectiles tested in pounds are as follows:

Proj. Band	Empty	Filler	Fuze	Total
experimental	9.41	0.83	2.48	12.72
* standard	9.45	0.81	2.48	12.74

* Standard copper band, reference (e) data.

7. PROCEDURE:

a. Mass Distribution Test (3 rounds):

The determination of fragment mass distribution was conducted in a sawdust-filled chamber. Each projectile was supported on its side in a cane fiberboard box. After each detonation, the sawdust was sifted and the fragments collected, cleaned, classified, and photographed.

b. Velocity Test (3 rounds):

Fragment velocity measurements were obtained by the usual high-speed photographic technique using a 35mm Fastax camera. Fragment velocities obtained are the mean velocities over the first 30 feet of travel. The 30' radius velocity plates cover 1/3 of the total solid angle in polar zone 80°-108°.

c. Space Distribution Test (4 rounds):

Fragment space distribution measurements were made in an arena consisting of a complete circle twenty (20) feet in radius. The arena panels were 1/8" mild steel plate, five (5) feet high and marked off in 5° polar angle zones about the axis of the projectile with the nose pointed toward 0°. Complete fragment penetrations of the panels were counted.

8. RESULTS AND DISCUSSION:

For comparative purposes the fragmentation data for the 3"/50 Mk 33-0 projectile, having the standard copper rotating band, reported in reference (e), will be included in this report.

a. Space Distribution:

Detailed space distribution data are listed in Table I and the average fragment hits per round are summarized as follows:

Polar Zone	Average Number Hits on Total Zone	
	Welded-overlay	*Standard
0°-45°	3	2
45°-120°	334	318
120°-180°	7	4
Total	344	324

* Standard copper band, reference (e).

b. Fragment Velocity:

Detailed fragment velocity data are listed in Table II. The average median beam spray (80°-108°) velocities are as follows:

Beam Spray Median Velocities (ft/sec)	
Welded-overlay	*Standard
3090	3140

* Standard copper band, reference (e).

c. Mass Distribution:

Detailed fragment mass distribution data are listed in Table III. Photographs of the fragments are shown in Figures 1-3. The mass data are summarized as follows:

Mass Group (grams)	Average Number of Fragments Welded-overlay	*Standard
1-1/4 - 2-1/2	204	183
2-1/2 - 5	141	154
5 - 10	82	90
10 - 20	54	55
20 - 40	23	15
40 - 80	7	5
80 - 205	6	8
Total (1-1/4 - 205)	517	510

* Standard copper band, reference (e) data.

PART D

CONCLUSIONS

9. a. The fragmentation characteristics of the 3"/50 Mk 33 Mod 0 Projectiles, Composition A-3 loaded and assembled with VT Fuze Mk 72, did not change significantly when the welded-overlay rotating band was substituted for the standard copper rotating band.

b. The comparative characteristics are as follows:

	Welded-Overlay band	Standard copper band
Average number of effective beam spray in total zone 45°-120°	334	318
Beam spray median velocity (ft/sec)	3090	3140
Average Number of fragments (1-1/4 - 205 grams)	517	510

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

- -

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NPG REPORT NO. 1190

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Tenth Partial Report

on

Projectile Rotating Bands

and Related Components

- -

Final Report

on

Fragmentation Test of 3"/50 Projectiles Mk 33

Having Welded-Overlay Rotating Bands

X

Project No.: NPG-Re3b-225-1-53
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Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE I

SPACE DISTRIBUTION DATA

3"/50 Projectiles Mk 33-0 with Welded-Overlay Rotating Bands

20 ft. Radius Circular Space Arena 1/8" MS panels 5' high

Zone Degrees	Rd. 1			Rd. 2			Rd. 3		
	R.	L.	Avg.	R.	L.	Avg.	R.	L.	Avg.
0-5	1/2	1/2	0.5	1/2	1/2	0.5	1/2	1/2	0.5
5-10									
10-15									
15-20									
20-25									
25-30									
30-35									
35-40									
40-45					1	0.5			
45-50									
50-55					2	1.0		1	0.5
55-60	1	2	1.5	2		1.0			
60-65									
65-70		1	0.5						
70-75							1	1	1.0
75-80		1	0.5		1	0.5			
80-85	2		1.0	1	2	1.5			
85-90	2	3	2.5		3	1.5			
90-95	1	7	4.0	2	5	3.5	4	4	4.0
95-100	5	2	3.5	7	2	4.5	4	2	3.0
100-105	1	1	1.0	4	2	3.0			
105-110	2		1.0					2	1.0
110-115	1	1	1.0	3		1.5			
115-120									
120-125									
125-130									
130-135									
135-140									
140-145									
145-150									
150-155									
155-160									
160-165									
165-170									
170-175									
175-180	3	3	3.0	3	4	3.5	3	4	3.5

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE I (Continued)

20 ft. Radius Circular Space Arena 1/8" MS panels 5' high

Zone Degrees	Rd. 4 R.	Rd. 4 L.	Rd. 4 Avg.	Avg. Impacts Per 5° Zone on Panel	Avg. Impacts Per Total 5° Zone on Panel	Avg. Impacts Per Unit Solid Angle
0-5	1/2	1/2	0.5	0.5	1	40
5-10						
10-15						
15-20						
20-25						
25-30						
30-35						
35-40						
40-45				0.1	1.7	5
45-50						
50-55				0.4	8	18
55-60				0.6	13	30
60-65	1		0.5	0.1	2	5
65-70				0.1	2	5
70-75	1		0.5	0.4	10	18
75-80				0.3	7	14
80-85				0.6	15	30
85-90	2	1	1.5	1.4	35	65
90-95	5	3	4.0	3.9	98	180
95-100	5	1	3.0	3.5	88	161
100-105				1.0	20	50
105-110		1	0.5	0.6	14	30
110-115	2		1.0	0.9	20	40
115-120		1	0.5	0.1	2	5
120-125						
125-130						
130-135						
135-140						
140-145						
145-150						
150-155						
155-160						
160-165						
165-170						
170-175						
175-180	6	3	4.5	3.6	7.2	300

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE II

FRAGMENT VELOCITY DATA

30 ft. Radius Velocity Arena
35mm Fastax Camera No. 1
Rd. No. 1, 3"/50 AA Mk 33-0 Projectile with welded-overlay band
Filler: Comp. A-3

2900 frames per second
Fuze: Mk 72 VT (Modified)
Total weight: 12.70 lbs.
Filler weight: .83 lbs.
Date: 16 July 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
25	2	3480
26	6	3350
27	5	3220
28	11	3110
29	3	3000
30	6	2900
31	6	2810
32	2	2720
33	2	2640
Median		3110
Average		3050

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE II (Continued)

30 ft. Radius Velocity Arena
35mm Fastax Camera No. 1
Rd. No. 2, 3"/50 AA Mk 33-0 Projectile with welded-overlay band
Filler: Comp. A-3

3250 frames per second
Fuze: Mk 72 VT (Modified)
Total weight: 12.72 lbs.
Filler weight: .83 lbs.
Date: 16 July 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
29	3	3360
30	10	3250
31	4	3150
32	9	3050
33	3	2950
34	2	2870
35	3	2790
36	4	2710
37	4	2640
38	2	2570
Median		3070
Average		3000

Fragmentation Test of 3"/50 Projectiles Mk 33
Having Welded-Overlay Rotating Bands

TABLE II (Continued)

30 ft. Radius Velocity Arena
35mm Fastax Camera No. 1
Rd. No. 3, 3"/50 AA Mk 33-0 Projectile with welded-overlay band
Filler: Comp. A-3

3250 frames per second
Fuze: Mk 72 VT (Modified)
Total weight: 12.72 lbs.
Filler weight: .83 lbs.
Date: 16 July 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
29	2	3360
30	9	3250
31	7	3150
32	3	3050
33	3	2950
34	2	2870
35	2	2790
36	1	2710
37	4	2640
38	2	2570
Median		3090
Average		3020

TABLE III

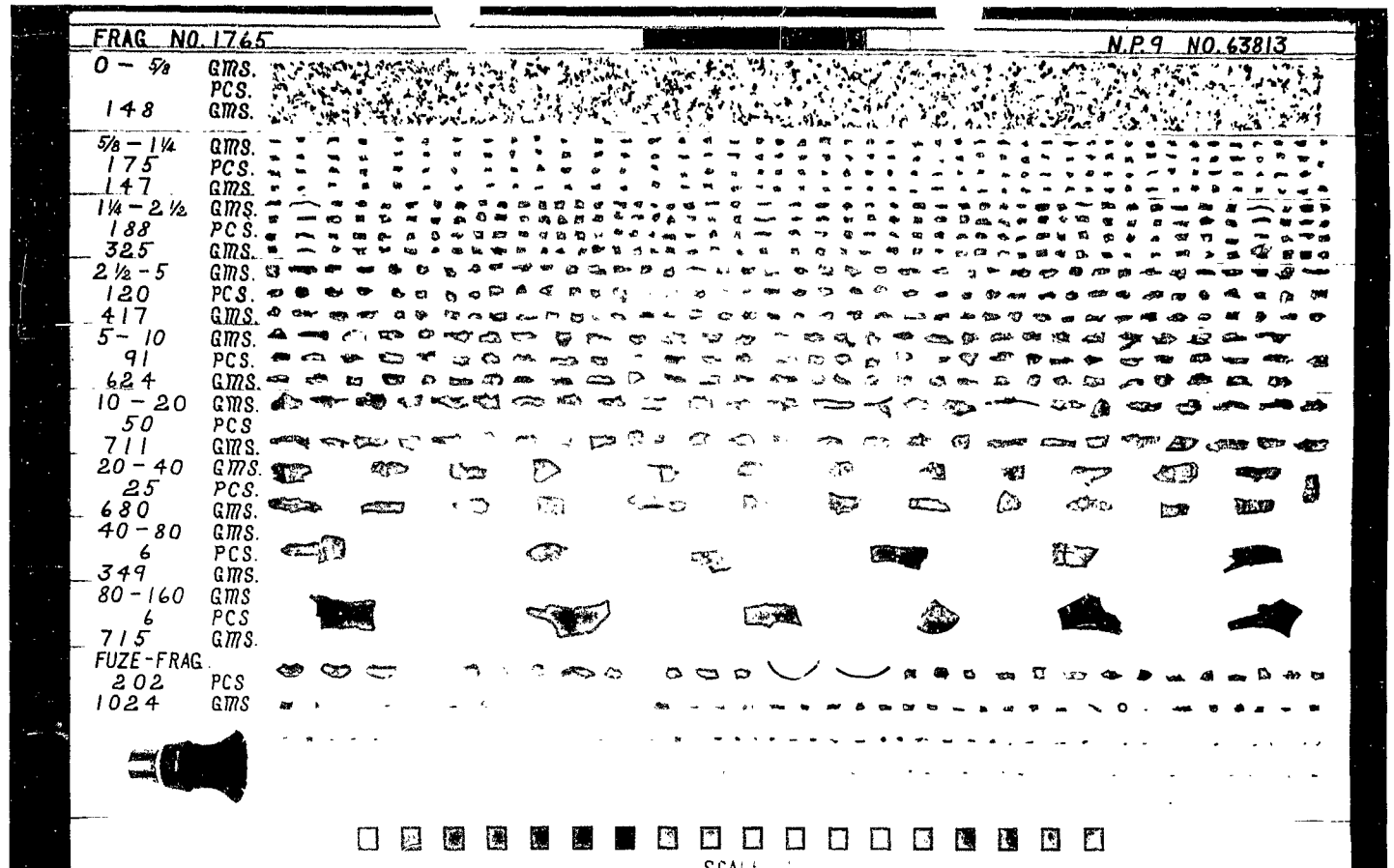
MASS DISTRIBUTION DATA

Fuze: Mk 72 VT

Fragment Mass Distribution of 3"/50 Projectiles Mk 33, Comp. A-3 Loaded, Having Welded-Overlay Rotating Bands

Rd. No.	Comp. Wt. lb.	Filler Wt. lb.	NUMBER AND WEIGHT OF RECOVERED FRAGMENTS																				Photo. No. NP9
			0-0.625 grams	0.625-1.25 grams		1.25-2.5 grams		2.5-5 grams		5-10 grams		10-20 grams		20-40 grams		40-80 grams		80-160 grams		160-320 grams		Fuze Frags		Total	
			Wt. Gms.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	Wt. Gms.	No.	No.	Gms.	
1	12.66	0.83	148	147	175	325	188	417	120	624	91	711	50	680	25	349	6	715	6	--	--	1024	202	863	5140	63813
2	12.75	0.83	181	206	236	326	190	530	155	472	71	871	60	546	22	414	7	635	6	--	--	1013	231	978	5194	63838
3	12.74	0.83	178	189	209	407	235	512	148	573	85	723	52	585	23	405	7	597	6	--	--	1005	222	987	5174	63905
Avg.	12.72	0.83	169	181	207	353	204	486	141	556	82	768	54	604	23	389	7	649	6	--	--	1014	218	943	5169	
*** Avg.	12.74	0.81	**	**	**	327	183	540	154	617	90	739	55	386	15	254	5	785	7	204	1	1025	114	*624	5213	

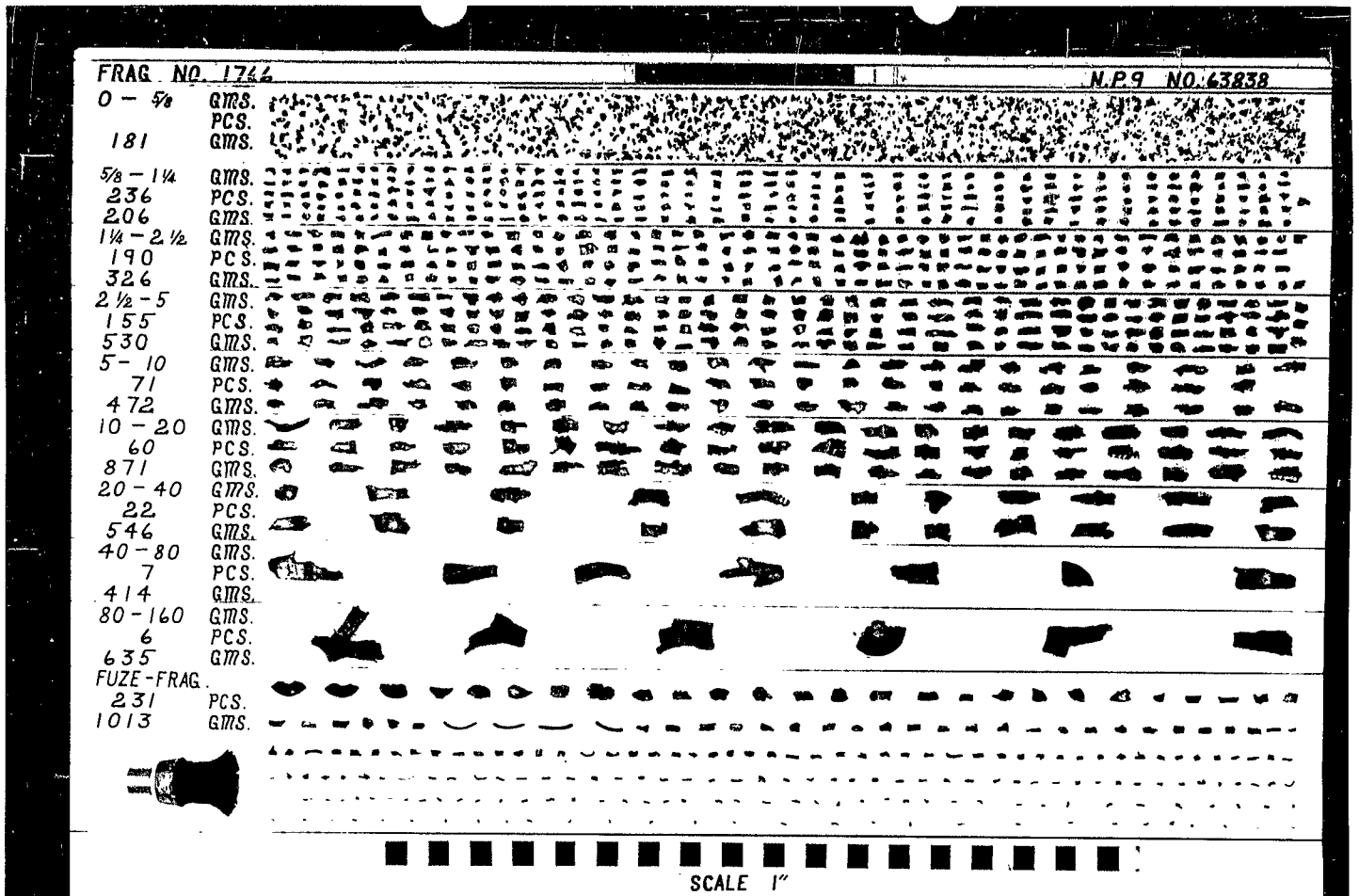
* Total number does not include 0.625-1.25 gram group.
** 0-1.25 gram group, weight was 336 grams.
*** Reference (e) data, 5 round average of 3"/50 Mk 33 Projectiles, Comp. A-3 loaded, having standard copper rotating bands.



NP9-63813 21 July 1953 CONFIDENTIAL SECURITY INFORMATION

Rd. 1. Fragment mass distribution of 3"/50 Projectile Mk 33, Composition A-3 loaded, having welded-overlay rotating band.

FIGURE 1



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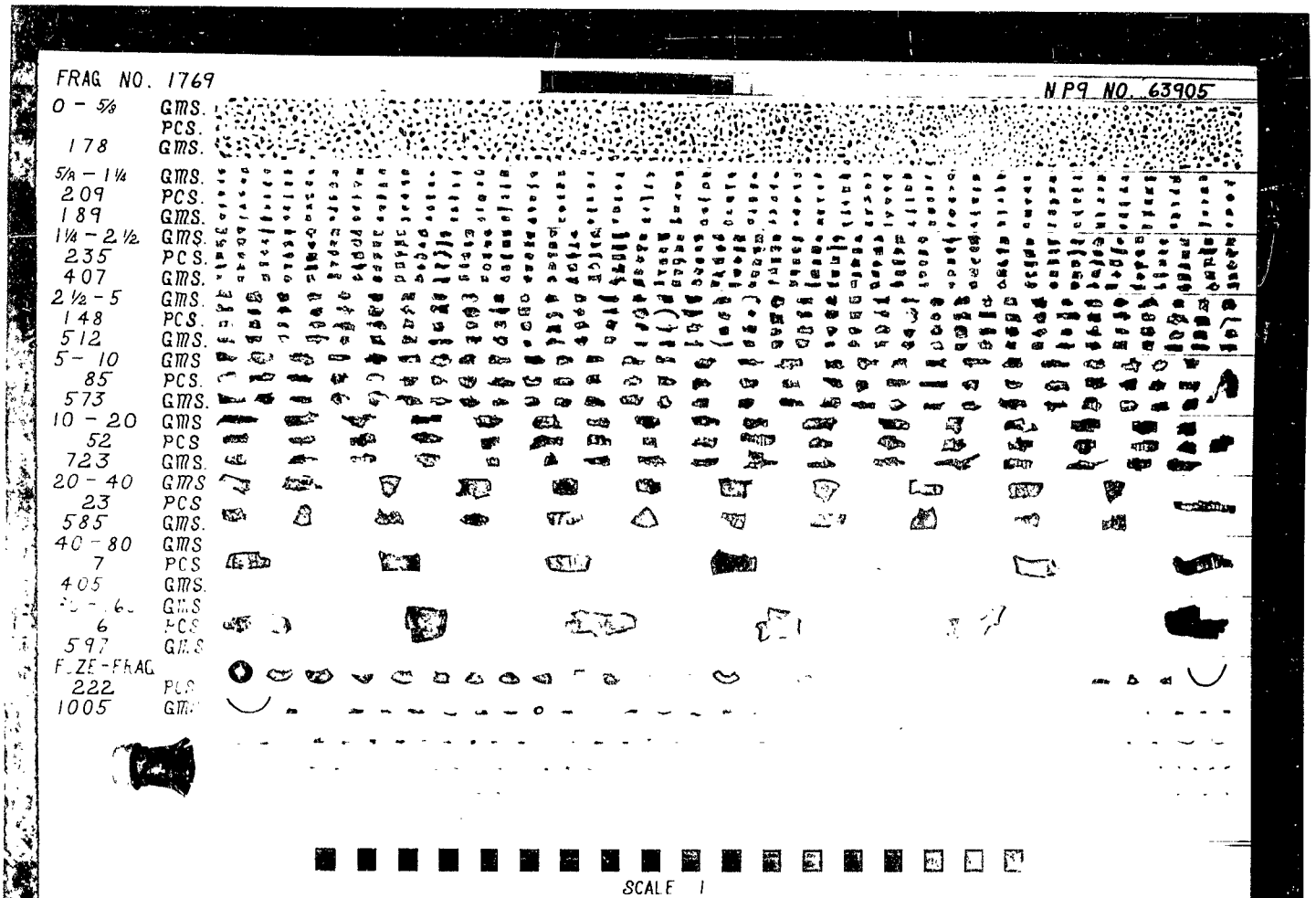
Rd. 2. Fragment mass distribution of 3"/50 Projectile Mk 33, Composition A-3 loaded, having welded-overlay rotating band.

FIGURE 2



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Rd. 3. Fragment mass distribution of 3"/50 Projectile Mk 33, Composition A-3 loaded, having welded-overlay rotating band.

FIGURE 3